



**REMEDIAL INVESTIGATION REPORT  
ARCO'S FORMER BULK STORAGE TERMINAL  
1111 DELANCEY STREET  
NEWARK, NEW JERSEY  
ISRA CASE NO. 86649**

**VOLUME I OF VI**

**November 1994**

**Prepared for**

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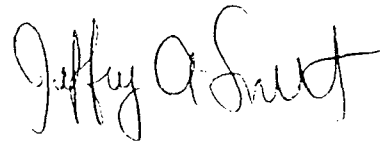
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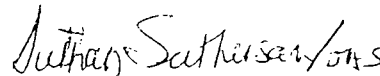
Geraghty & Miller, Inc. is submitting this report to ARCO Products Company for work performed at ARCO's former bulk storage terminal located at 1111 Delancey Street, Newark, New Jersey. This report was prepared in conformance with Geraghty & Miller's strict quality assurance/quality control procedures to ensure that the report meets industry standards in terms of the methods used and the information presented. If you have any questions or comments concerning this report, please contact one of the individuals listed below.

Respectfully submitted,

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**INTRODUCTION**

Geraghty & Miller, Inc. was retained in May 1993 by ARCO Products Company to provide environmental consulting services associated with on-going Industrial Site Recovery Act (ISRA) investigation activities at ARCO's former petroleum storage terminal in Newark, New Jersey. On December 20, 1989, the Cleanup Plan prepared for ARCO in association with the cessation of operations and pending sale of the Newark Terminal was approved by the New Jersey Department of Environmental Protection (NJDEP). From April 1990 to June 1991, approximately 15,000 cubic yards of soils were excavated, remediated on-site using a low temperature thermal desorption unit, and backfilled. Other assessment activities continued since 1990 including, the monthly gauging of liquidlevels and product recovery in site observation wells and piezometers, additional soil sampling and observation well installation near the loading rack and Propane Power areas, and evaluating alternative septic/wastewater handling facilities.

In an October 12, 1993 letter, the NJDEP identified remaining areas of concern based on their comparison of post-excavation soil sampling data to the February 1994 revised proposed cleanup standards for Residential and Non-residential surface soils. In an April 7, 1994 letter, the NJDEP requested ARCO provide the agency with a schedule of remedial activities that will be conducted to comply with the October 12, 1993 letter. The NJDEP also requested ARCO and Hess (the current owner) to provide a signed, notarized Declaration of Environmental Restriction (DER) for the site. A schedule of remedial activities was submitted by ARCO to the NJDEP on May 13, 1994. A letter was submitted jointly by ARCO and Hess to the NJDEP on July 12, 1994 regarding the status of discussions associated with filing a DER for the site.

As stated in the July 12, 1994 letter to the NJDEP, a final DER for the site should be completed after final assessment and appropriate remedial action are completed, if required. A Remedial Investigation Workplan to evaluate the conditions and define the extent of petroleum hydrocarbons in soils at the Loading Rack, Septic Tank/Leach Field, and Propane Power areas at the Newark terminal was submitted to the NJDEP on July 29, 1994. The workplan was conditionally approved by the NJDEP in a letter dated September 15, 1994 which requested further investigation of three areas; the former 1,000-gallon waste oil underground storage tank (UST-3) and two oil/water separators (OWS-1 and the OWS-2).

All areas were investigated from October 11 through 25, 1994. The results obtained from this investigation were used to evaluate soil conditions and provide data to evaluate potential remedial alternatives, if warranted. The results are summarized in this Remedial Investigation Report which was prepared in accordance with the Technical Requirements for Site Remediation described in N.J.A.C. 7:26E-4.9.

### **SITE BACKGROUND**

#### **SURROUNDING LAND USE**

The Newark terminal is located on the west bank of Newark Bay in a highly industrialized area adjacent to Port Newark (Figure 1). The area was previously a tidal marshlands which was reclaimed by artificial drainage and landfill operations prior to ARCO's occupancy in 1946. Aerial photographs of this area indicate that the region was essentially fully developed with industrial facilities by the 1950's. Area reconnaissance of the Newark and Port Newark area reveals a highly active industrial area with very limited undeveloped land. Six bulk petroleum terminals have been identified in a two mile distance along the west shore of Newark Bay near the former ARCO site. Significant curtailment of industrial operations in this area in the near future is improbable, and

continued use for bulk petroleum operations is expected given the vast network of underground pipelines supplying the area and continued access to favorable shipping channels.

The immediate area surrounding the ARCO Newark Terminal has been subject to numerous explosions, fires, spills and other environmental incidents over the years. Of particular note are fires and explosions at Texaco, Inc. and McKesson Envirosystem facilities in the 1980's. The Texaco fire and explosion(s) occurred on property along the southwestern boundary of the Newark Terminal. The fire apparently resulted from a tank overfill and the subsequent ignition of vapors at the adjacent Central Steel Drum Company facility. Additional information regarding the Texaco fire is available in the Department's case files.

## **HISTORICAL SITE LAND USE**

The Newark Terminal is a non-production bulk petroleum storage and distribution terminal supplied by pipeline with distribution by truck and barge. The facility is located at 1111 Delancey Street in Newark, Essex County, New Jersey on the west bank of Newark Bay in a highly industrialized area adjacent to Port Newark. The site location is shown on Figure 1. The former ARCO property is bounded by the Newark Bay to the east; undeveloped land to the southwest, a Texaco, Inc. bulk petroleum terminal to the northeast, and a drum reclamation business operated by the Central Steel Drum Company to the northwest.

The former ARCO property encompasses approximately 60 acres of land, of which 22 acres have been developed. The Newark terminal occupies 21 acres bordering Newark Bay, and one acre was formerly leased to the Propane Power Corporation for bulk storage and distribution of propane. The remaining 38 acres of the property remain undeveloped and consist mostly of marshland overgrown with reeds. The site layout is shown on Figure 2.



ARCO originally purchased the property as undeveloped land in 1946 at which time they constructed the terminal facility. Petroleum products stored at and distributed from the terminal during its history of operation have included various grades and types of gasoline, kerosene, No. 2 fuel oil, and motor oil. With the exception of motor oil, all such products were stored in 10 aboveground steel storage tanks ranging in size from 1.26 million gallons to 4.78 million gallons, with a total storage capacity of approximately 27.6 million gallons. Motor oil was stored in four aboveground 6,000-gallon steel tanks which were removed subsequent to the cessation of these operations in 1965.

## **AREAS OF INVESTIGATION**

Three areas of investigation at the Newark terminal were identified in the Remedial Investigation Workplan to evaluate conditions and define the extent of petroleum hydrocarbons in soils. Three additional areas (the former UST-3, and oil/water separators OWS-1, and OWS-2) were identified by the NJDEP conditional workplan approval letter dated September 15, 1994. The Loading Rack and Septic Tank/Leach Field areas are currently operational areas at the terminal. Operations in the Propane Power area ceased in 1992. The former UST-3 and OWS-1 are located within the loading rack area. The OWS-2 is located outside the petroleum storage tank (PST-8) area. Each of these areas has been previously investigated and/or the focus of remedial efforts and are described in further detail below.

### **Loading Rack - History and Further Assessment Rationale**

Historically the loading rack has and continues to be used for loading tank trucks with fuel for distribution and sale. The loading rack is asphalt paved and encompasses an area of approximately 75,500 square feet. Separate-phase product was discovered on the groundwater surface in wells installed in the Loading Rack Area during preliminary investigations conducted in 1987.

As many as 20 observation wells and piezometers have been installed in the loading rack area to evaluate groundwater conditions. The location of observation wells and piezometers at the Newark terminal are shown on Figure 2.

ARCO continues to measure the depth-to-water and product, if present, in these observation wells and piezometers as part of monthly well gauging activities. Separate-phase product is hand bailed from wells that contain measurable product and placed in aboveground storage tanks used for product recovery at the site.

A recovery trench, equipped with six skimmer pumps, was installed north and east of the loading rack to prevent potential off-site migration of separate-phase product. The separate-phase product present has been described as a weathered, degraded, and highly viscous product. Given the nature of the product and low permeability of shallow soils, little to no product has migrated. The product recovery trench is monitored monthly for accumulated separate-phase product but the skimmer pumps have not needed to be operated.

Recent monthly well gauging data collected from 45 wells and piezometers at the site indicate separate-phase product is only encountered in a five to six observation wells that are located beneath the asphalt and adjacent to the active loading rack. Apparent product thicknesses measured in these wells typically range from a few tenths to hundredths of a foot.

On November 16 and 17, 1992, one soil sample was collected in each of five borings (MW-11, MW-12, MW-13, MW-14, and MW-15) that were drilled in the Loading Rack Area. The samples were collected from unsaturated soils immediately above the water table and submitted to the laboratory for total petroleum hydrocarbons analysis using USEPA Modified Method 8015.

indicate total petroleum hydrocarbon concentrations detected in these samples ranged from 3,500 parts per million to 15,000 parts per million. The concentrations in two samples, MW-11 (15,000 parts per million) and MW-14 (13,000 parts per million), exceed the proposed NJDEP total organic compound cleanup standard of 10,000 parts per million. Based on these data, the NJDEP has requested further soil sampling to assess soil conditions in the loading rack area.

#### **Septic Tank/Leach Field - History and Further Assessment Rationale**

Reportedly, two septic tanks and a leach field are located southwest of the maintenance garage and west of the Loading Rack area. Floor drains from the garage were reported to have formerly discharged to this septic system but the drains were plugged by ARCO in December 1989. The septic system is currently active and handles sanitary wastes generated at the facility. The entire system is scheduled to be removed and soils excavated pending approvals for a hookup to a private sanitary sewer line that is being installed along Delancey Street north of the facility.

In 1987, C-E Environmental, Inc. drilled three borings and collected soil samples outside the southwestern fence line around the septic leach field. Two soil samples were collected from each boring and analyzed for total petroleum hydrocarbons. Samples were collected from two borings (B-12 and B-13) at depths of 0.0 - 0.5 feet below ground surface and 1.5 - 2.0 feet below ground surface. Samples were collected from the third boring (B-14) at depths of 0.0 - 0.5 feet below ground surface and 1.0 - 1.5 feet below ground surface. The B-12 deeper sample was additionally analyzed for volatile organic compounds and the B-12 shallow sample was additionally analyzed for base neutral compounds. This investigation and the analytical results were described in the January 31, 1989 report prepared by Roux Associates, Inc. entitled, "Sampling Plan Summary and Conceptual Cleanup Plan Objectives".

Total petroleum hydrocarbon concentrations for the B-12 samples were 120 parts per million (0.0 - 0.5 feet below ground surface) and 440 parts per million (1.5 - 2.0 feet below ground surface).

The total volatile organic compound concentration for the B-12 (1.5 - 2.0 feet below ground surface) sample was 0.52 parts per million. The total base neutral compound concentration for the B-12 (0.0 - 0.5 feet below ground surface) sample was 5.58 parts per million.

Total petroleum hydrocarbon concentrations for the B-13 samples were 500 parts per million (0.0 - 0.5 feet below ground surface) and 9,700 parts per million (1.5 - 2.0 feet below ground surface). Total petroleum hydrocarbon concentrations for the B-14 samples were 430 parts per million (0.0 - 0.5 feet below ground surface) and 920 parts per million (1.0 - 1.5 feet below ground surface). The B-13 and B-14 samples were not analyzed for volatile organic compounds or base neutral compounds.

The 1989 Cleanup Plan stipulated the removal of the septic system and associated soils which will be initiated after a sewer tie-in from the Newark terminal is completed. Soil samples are being collected during this investigation to augment previous soil sampling data collected near the septic field and to further assess these soil conditions.

#### **Propane Power - History and Further Assessment Rationale**

The Propane Power area is located approximately 260 feet northwest of the Loading Rack area and encompasses approximately 50,000 square feet. Propane Power Corporation formerly leased this portion of the property from ARCO for bulk storage and distribution of propane until 1991. Operations continued after the sale of the property until 1992. Soils in two areas, one at the eastern corner and one at the southwestern corner of the Propane Power area, were excavated and remediated during 1989 - 1991 ECRA Cleanup activities. On December 7, 1992, two soil samples (2R00425-010 and 2R1030-004) were collected from the sidewall of a test pit. The test pit was excavated immediately beyond the former western extent of an area previously excavated and remediated at the eastern corner of Propane Power. The total petroleum hydrocarbon concentration

remediated at the eastern corner of Propane Power. The total petroleum hydrocarbon concentration detected in the 2R00425-010 sample was 22,000 parts per million which exceeds the NJDEP's proposed total organic compound cleanup standard of 10,000 parts per million.

### **PHYSICAL SETTING**

#### **SOILS**

The area was previously a tidal marshlands which was reclaimed by artificial drainage and landfill operations prior to ARCO's occupancy in 1946. The Soil Conservation Service designates the entire property as "made land" (Soil Survey of the Bergen Area, NJ - Series 1925, #32).

#### **GEOLOGY**

The Newark terminal is situated in the Piedmont Physiographic Province in the flat, low lying plains of eastern Essex County, New Jersey. The Triassic-age Brunswick Formation and Watchung Basalt of the Newark Group comprise the bedrock beneath Essex County. These bedrock formations strike northeast-southwest and dip to the northwest. Bedrock is overlain by Pleistocene glacial deposits comprised of clays, silts, sands, and gravel. Bedrock topography controls the thickness of glacial deposits in Essex County and these deposits may be as thick as 200 feet in the bedrock valleys in the Newark area. These glacial deposits in the ancient river valleys range in thickness from 0 to 70 feet. Near the Newark terminal, these glacial deposits are dissected and not pervasive.

The Pleistocene glacial deposits are overlain by Recent marsh deposits comprised of muds, silts and clays with peat and organic matter. These fine-grained sediments serve as a semi-confining hydrologic unit that is up to 35 feet thick in Essex County.

The marsh deposits are overlain by fill deposits that were emplaced during artificial drainage and landfill operations from extensive industrial development. Reported observations of site soil conditions during investigation and remediation activities indicate the fill deposits include dredged material from Newark Bay, trash, and debris. Soil boring data at the site indicate the fill deposits range from 5 to 25 feet thick and no boring has penetrated the underlying marsh deposits. Reportedly, data from nearby water supply well logs indicate the bedrock surface of the Brunswick Formation is approximately 85 feet below ground surface.

## **HYDROGEOLOGY**

A detailed description of area and site hydrogeologic conditions is provided in reports prepared by Roux Associates, Inc. entitled, "Sampling Plan Summary and Conceptual Cleanup Plan Objectives, January 31, 1989" and "Project Update Report, ECRA Case Number 86649, December 12, 1991". A summary of hydrogeologic conditions from these reports is provided below.

The unconsolidated Pleistocene deposits and the underlying consolidated bedrock formations reportedly have the potential to yield significant quantities of groundwater. The wells in the Brunswick Formation in Essex County having the highest yields are typically completed between 300 and 400 feet below ground surface.

The water table near the site is encountered at shallow depths within the fill deposits. Depth to water at the Newark terminal averages approximately 2 to 5 feet below ground surface. The fill material are heterogeneous, both laterally and vertically, and have relatively low permeabilities. Local variations in groundwater head apparently related to the heterogeneity of the fill, are common. The general groundwater flow direction at the site is to the east toward Newark Bay which is a local discharge area.

## TOPOGRAPHY

The topography of the site is generally flat. Surface elevations at the site are approximately 8 feet above mean sea level.

## SURFACE WATER BODIES

The ARCO Newark terminal is located within the lower Passaic River drainage basin along the western shore of the Newark Bay at the confluence of the Passaic and Hackensack Rivers. Water quality in the lower Passaic River and Newark Bay is generally poor. The NJDEP has classified Newark Bay as SE3 Waters and has established appropriate water quality standards based on this classification. Additionally, the Interstate Sanitation Commission has classified these waters as Class B-2. Both these ratings represent the lowest classification possible and are indicative of the extensive development, highly industrialized nature, and numerous wastewater discharges and non-point pollution sources in the area.

Site surface water runoff in operational areas is diverted to oil-water separator units prior to discharge. Surface water runoff in non-operational and undeveloped areas primarily discharges along the eastern property boundary to Newark Bay.

## TECHNICAL OVERVIEW

The remedial investigation was conducted to evaluate the conditions and define the extent of petroleum hydrocarbons in soils at the Loading Rack, Septic Tank/Leach Field, and Propane Power areas at the Newark terminal. As requested in the September 15, 1994 conditional approval letter from the NJDEP, two 10,000-gallon oil/water separators (OWS-1 and OWS-2) were further evaluated. Also, a shallow observation well was installed within 10 feet of the former UST-3. The assessment of this former UST has historically been incorporated with area wide assessments of the

loading rack. Post-excavation soil samples were previously collected from soils associated with this former UST and no additional soil samples to specifically assess this UST were collected during this investigation.

The results obtained from this investigation were used to evaluate soil conditions and potential soil remedial alternatives, if warranted. The investigation was conducted in accordance with the NJDEPE Technical Requirements for Site Remediation and the Remedial Investigation requirements in N.J.A.C. 7:26E-4.1 and 4.3. The execution of the investigation is described below.

## **INVESTIGATION METHODOLOGY**

The field investigation included the following: eight shallow soil borings in the Loading Rack area and the installation of one observation well near the former UST-3; six shallow soil borings in the Septic Leach Field area; one shallow soil boring near the previous sample location (sample #2R0425-010) where elevated concentrations of total petroleum hydrocarbons were detected in soils near Propane Power; four soil borings at former boring locations B28, B29, B30, and B31 near OWS-1; and one soil boring at former boring location B51 near OWS-2. The physical description of soils encountered are provided in Appendix A.

### **Soil Sampling**

In the Loading Rack area, two soil samples were collected from each boring; one from the unsaturated soils beneath the asphalt and above the shallow water table, and one from the saturated soils below the water table in accordance with the NJDEP Technical Requirements. Three soil samples were collected from each boring completed in the Septic Tank Leach Field and Propane Power areas. One soil sample was collected from each of the borings near oil/water separators OWS-1 and OWS-2. The soil sampling summary is provided in Table 1 and the sampling locations are shown on Figure 3.



Soil samples were collected using a 4-1/2-inch diameter, cleaned, stainless steel, hand auger. Due to concerns and uncertainty associated with the locations of underground utilities, a drill rig with a split-spoon sampling device could not be used to collect soil samples. The NJDEP was notified of this modification to the approved workplan in a letter dated October 5, 1994. The soil samples were visually inspected and field-screened using a calibrated Flame Ionization detector (FID). A description of the soil type, appearance, FID readings, and other field observations were noted on field logs which are provided in Appendix A. The hand auger was properly decontaminated before and after collecting each sample. Samples for analysis were prepared in laboratory-supplied bottles, stored on ice in a cooler with appropriate chain of custody documentation, and shipped overnight delivery to a New Jersey-certified laboratory for analysis.

### **Soil Analysis**

Soil samples collected from each boring in the Loading Rack, Septic Tank Leach Field and Propane Power areas were analyzed for total petroleum hydrocarbons using USEPA Modified Method 8015. A subset of these samples (approximately 25 percent of those with total petroleum hydrocarbons above 1,000 parts per million) were additionally analyzed for volatile organic compounds plus 10 library search compounds using USEPA Method 8240 and for polynuclear aromatic hydrocarbon (PAH) compounds using USEPA Method 8270. The soil samples collected near OWS-1 were analyzed for volatile organic compounds plus 10 library search compounds. The soil samples collected near OWS-2 were analyzed for lead. All samples were analyzed by Analytical Technologies, Inc. (ATI) of Pensacola, Florida, which is a New Jersey-certified laboratory (Certification No. 49081).

Based on field observations of soils, a subset of the total number of samples collected were analyzed for microbiological activity parameters (total and specific degraders, respirometry, and macro-nutrients) to evaluate the natural microbial activity in soils capable of degrading petroleum

hydrocarbons. The analyses of these microbiological parameters were performed by Acurex Environmental, Inc. of Durham, North Carolina.

#### **Observation Well Installation**

Observation well GMW-17 was installed within 10 feet of the former UST-3 excavation by Plainfield Well Drilling Company of Martinsville, New Jersey, a New Jersey licensed driller, using a hollow stem auger drill rig. The well was installed and developed on October 25, 1994 and is constructed of ~~2 feet~~<sup>2-12</sup> of 4-inch diameter PVC casing and 10 feet of PVC well screen which intercepts the water table. An as-built well construction diagram, well permit, and monitoring well record is provided in Appendix B.

### **INVESTIGATION RESULTS**

#### **Loading Rack**

A total of 16 soil samples from the Loading Rack area were analyzed for total petroleum hydrocarbons, as shown in Table 2. Total petroleum hydrocarbon concentrations in soil samples collected from above the water table at depths between 1.3 to 2.0 ft bgs ranged from 62 to 13,000 parts per million. Total petroleum hydrocarbons concentrations in soil samples collected below the water table at depths between 3.1 to 5.3 ft bgs ranged from 6 to 4,400 mg/kg. Shallow soil sample LR-4 (1.5 - 2.0) (13,000 parts per million) was the only sample collected in the Loading Rack area during this investigation that contained total petroleum hydrocarbons at a concentration above the proposed NJDEP total organic cap of 10,000 ppm in soil. The laboratory analytical results for total petroleum hydrocarbons are summarized in Table 2 and on Figure 4.

Three of the soil samples collected from the Loading Rack area (LR-1 [1.5-2.0], LR-6 [1.5-2.0], and LR-7 [1.3-1.7]) were also analyzed for volatile organic compounds plus 10 library

compounds and PAHs. The laboratory analytical results for volatile organic compounds are summarized in Table 3 and Figure 5. The laboratory analytical results for PAHs are summarized in Table 3 and Figure 6.

All three soil samples were collected from unsaturated soils between 1.3 and 2.0 feet below ground surface. Benzene, toluene, ethylbenzene, xylenes (BTEX), acetone, and 2-butanone were the only volatile organic compounds detected in the three Loading Rack soil samples. Benzene was detected in soil sample LR-7 (1.3 - 2.0) at a concentration of 23 parts per million which is above the proposed NJDEP non-residential soil cleanup standard of 13 parts per million for benzene. No other volatile organic compounds were detected in any of the three Loading Rack soil samples at concentrations above the applicable proposed NJDEP non-residential soil cleanup standards.

No PAH's were detected in any of the loading rack area soil samples at concentrations above the proposed NJDEP non-residential soil cleanup standards. Detection limits for benzo(a)pyrene in the LR-1 sample and benzo(k)fluoranthene and indeno (1,2,3-cd)pyrene in the LR-7 sample were elevated above the proposed NJDEP non-residential soil cleanup standards for these compounds.

The NJDEP's September 15, 1994 conditional approval letter requested soil samples be collected near OWS-1, which was located within the Loading Rack area. Four subsurface soil samples were collected from former boring locations B-28, B-29, B-30, and B-31 near OWS-1 and analyzed for volatile organic compounds plus 10 library compounds. Previous samples collected from these former boring locations were not analyzed for volatile organic compounds. The analytical results are summarized in Table 3 and on Figure 5.

The only volatile organic compounds detected in these samples were acetone, 2-butanone, benzene, ethylbenzene, and xylenes. Benzene was detected at a concentration of 1.8 parts per million which is above the proposed NJDEP impact to groundwater standard of 1 part per million

for benzene. No other volatile organic compounds were detected in any of the samples collected near OWS-1 at concentrations above the proposed NJDEP impact to groundwater soil cleanup standards.

### **Septic Tank/Leach Field**

A total of 18 soil samples were collected near the Septic Tank/Leach Field area and analyzed for total petroleum hydrocarbons. The laboratory analytical results for total petroleum hydrocarbons are summarized in Table 2 and on Figure 4. Total petroleum hydrocarbons concentrations in surficial soil samples from depths of 0 to 0.5 ft bgs ranged from 600 to 26,000 parts per million. Total petroleum hydrocarbons concentrations in surficial soil samples collected from above the water table at depths from 1.5 to 2.0 ft bgs ranged from 8,300 to 14,000 parts per million while total petroleum hydrocarbons concentrations in subsurface soil samples collected below the water table at depths from 3.1 to 4.7 ft bgs ranged from 1,100 to 6,000 parts per million. Three of six surficial soil samples (ST-1, ST-3, and ST-5) contained total petroleum hydrocarbons at concentrations above the proposed NJDEP total organic soil standard of 10,000 parts per million. Four of six soil samples collected immediately above the water table (ST-1, ST-2, ST-3, and ST-4) contained total petroleum hydrocarbons at concentrations above the proposed NJDEP total organic standard of 10,000 parts per million. None of the soil samples collected from below the water table contained total petroleum hydrocarbons at concentrations above the proposed NJDEP total organic standard of 10,000 parts per million.

A total of three of the soil samples collected near the Septic Tank/Leach Field area were also analyzed for volatile organic compounds plus 10 library compounds and PAHs. The laboratory analytical results for volatile organic compounds are summarized in Table 3 and on Figure 5. The laboratory analytical results for PAHs are summarized in Table 3 and on Figure 6.

Two soil samples (ST-4 [0.0 - 0.5 ft bgs] and ST-6 [1.5 - 2.0] ft bgs)) were collected above the water table while one soil sample (ST-3 [3.8 - 4.4 ft bgs]) was collected below the water table. Benzene, toluene, ethylbenzene, xylenes (BTEX) were the only volatile organic compounds detected in these samples. Benzene was detected in the ST-6 (1.5 - 2.0) surface soil sample at a concentration of 27 parts per million which is above the proposed NJDEP non-residential soil cleanup standard of 13 parts per million for benzene. Benzene, ethylbenzene, and xylenes were detected in the ST-3 (3.8 - 4.4) subsurface soil sample at concentrations above the proposed NJDEP impact to groundwater soil cleanup standards of 1 part per million for benzene, 100 parts per million for ethylbenzene, and 10 parts per million for xylenes. No other volatile organic compounds were detected in any of the three septic leach field samples at concentrations above the applicable proposed NJDEP soil cleanup standards.

Benzo (a ) pyrene was detected in the ST-4 (0 - 0.5) sample at a concentration of 3 parts per million which is above the non-residential cleanup standard of 0.66 parts per million for this compound. Benzo (a ) pyrene was the only PAH detected at a concentration above the proposed NJDEP non-residential soil cleanup standards in the septic leach field soil samples. The detection limits for benzo(a)pyrene, benzo(k)fluoranthene, and indeno (1,2,3-cd) pyrene in the ST-6 surface sample were above the proposed NJDEP non-residential soil standards.

### **Propane Power**

Three soil samples were collected from one boring (PP-1) drilled near the propane power area. Two surface soil samples (PP-1(0-0.5) and PP-1(1.5-2.0)) were collected above the water table and one sample (PP-1(4.4-5.0)) was collected below the water table. Field observations indicated a faint hydrocarbon odor and FID readings ranged from 0 to 100 parts per million in the soils encountered between 0 and 3 feet below ground surface. Total petroleum hydrocarbons were detected in these samples at concentrations ranging from 3,900 to 33,000 parts per million, as shown in Table 1 and on Figure 4. Total petroleum hydrocarbon concentrations in samples PP-1

(1.5 - 2.0) and PP-1 (4.4 - 5.0) were above the NJDEP total organic standard of 10,000 ppm. Based on field observations, no additional soil samples were collected near Propane Power during this investigation. Analytical data indicate that additional soil samples may be required to further assess the Propane Power area.

The PP-1 (0 - 0.5) sample was also analyzed for volatile organic compounds plus 10 library compounds and PAHs. The only volatile organic compound detected was benzene, which was detected at a concentration below the NJDEP non-residential soil cleanup standard of 13 parts per million. The analytical results for volatile organic compounds are summarized in Table 2 and on Figure 5.

Benzo (a ) pyrene was detected in the PP-1 (0-0.5) sample at a concentration of 0.740 parts per million which is above the proposed NJDEP non-residential soil cleanup standard of 0.66 parts per million. No other PAHs were detected above the NJDEP non-residential soil cleanup standards in the PP-1 sample. The PAH analytical results are summarized in Table 3 and on Figure 6.

## OWS-2

As required by the NJDEP September 15, 1994 conditional workplan approval letter, one soil sample was collected at the former B-51 soil boring location near OWS-2 and analyzed for lead. The sample location and analytical result are shown on Figure 7. Lead was detected at a concentration of 911 mg/kg in this soil sample collected near the OWS-2 area. The concentration of lead detected in this sample is the proposed NJDEP non-residential soil cleanup standard of 600 parts per million for lead.

## ANALYTICAL DATA QUALITY ASSURANCE

All analytical data were evaluated with regard to compliance with sample holding times, ability to achieve method detection limits, and precision and accuracy criteria for the analytical method. Precision data consist of results from laboratory matrix spike duplicates and is expressed in terms of a relative percent difference (RPD) between two analytical results. Accuracy is expressed as percent recovery.

All samples were analyzed within prescribed holding times and all method detection limits were achieved. No non-conformances were reported by ATI and the data are therefore considered reliable.

## NATURE OF CONTAMINATION

Based on the total petroleum hydrocarbons analytical data, soils containing total petroleum hydrocarbons above the proposed NJDEP total organic standard of 10,000 parts per million are primarily limited to surficial soils from 0 to 2 feet below ground surface in the septic leach field and loading rack areas. These soils are above the water table in the area of septic tank/leach field and to a lesser extent in the northern and western portions of the loading rack (see Figure 4). Total petroleum hydrocarbons above the proposed NJDEP total organic standard of 10,000 parts per million were detected in unsaturated surface soils below 1.5 feet and in saturated soils as deep as 5 feet below ground surface in the PP-1 broing. Soils immediately adjacent and northeast of the PP-1 sample location were previously excavated and remediated. Additional soil sampling southwest of the PP-1 soil sample location on the Propane Power property may be required to more completely assess the extent of petroleum hydrocarbons, if present.

Based on an evaluation of volatile organic compounds analytical data, benzene is the only volatile organic compound detected in surface soils at concentrations above the proposed NJDEP

non-residential soil cleanup standards (see Figure 5). Benzene was detected at a concentration above the proposed NJDEP non-residential soil cleanup standard of 13 parts per million in only two soil samples (LR-7 (1.3-1.7) and ST-6 (1.5-2.0)) collected and analyzed for volatile organic compounds. Benzene, ethylbenzene, and xylenes were detected at concentration above the proposed NJDEP impact to groundwater standard in subsurface soil sample ST-3 (3.8-4.4).

Benzo (a) Pyrene was detected in only two surface soil samples collected during this investigation at concentrations above the proposed NJDEP non-residential soil cleanup standard of 0.66 parts per million for benzo (a) pyrene. One of these samples (ST-4 (0-0.5)) was collected near the septic leach field and the other sample (PP-1 (0-0.5)) was collected near the Propane Power area. No other PAHs were detected in samples collected during this investigation at concentrations above the proposed NJDEP non-residential soil cleanup standards.

## **MICROBIOLOGICAL EVALUATION**

The microbiological evaluation was conducted of samples from above and below the water table at each of the three areas of investigation to determine if aerobic microbes are present and have adapted to degrade selected organic compounds and to determine if soluble inorganic nutrients are present in sufficient quantities for biodegradation of the contaminants. Benzene was selected as a carbon source for the microbiological evaluation since benzene is the most toxic constituent onsite and therefore the most critical in terms of potential biodegradation.

The results indicate that total heterotrophic microbial populations are present. Respirometry testing of the samples resulted in encouraging oxygen consumption rates. Nutrient limitations may affect microbial population dynamics. In general, the site appears to display conditions favorable to the implementation of bioremediation. The laboratory analytical package for the microbial evaluation is provided in Appendix D.



## CONCLUSIONS

Based on the data collected during this remedial investigation, further soil sampling may be required to more completely assess the extent of petroleum hydrocarbons at concentrations above the applicable NJDEP cleanup standards in soils. Specifically, additional sampling may be required southwest of the septic leach field area and on the former Propane Power property.

Microbiological sampling data indicate naturally occurring microbial populations capable of degrading selected organic compounds are present in soils at the site. Some of the greatest oxygen consumption rates measured in the ten samples analyzed were detected in the septic leach field samples which contained some of the higher total petroleum hydrocarbon concentrations.

As stated in the July 12, 1994 joint letter from ARCO and Hess to the NJDEP, a final Declaration of Environmental Restriction (DER) for the site will be completed after the final assessment and appropriate remedial action are completed, if required. ARCO and Hess are continuing discussions to develop a DER for the site that is acceptable to both parties and the NJDEP. ARCO is committed to conducting the additional soil sampling necessary to more completely assess the extent of petroleum hydrocarbons in soils near the septic leach field and Propane Power areas. An addendum to the July 29, 1994 remedial investigation workplan for the additional investigative tasks will be prepared and submitted to the NJDEP.

NP0191001/1106/94.rpt

Table 1. Soil Sampling Summary Table for Samples Collected on October 11, 12, 13 and 14, 1994, ARCO's Former Bulk Storage Terminal, Newark, New Jersey.

<u>LOCATION</u>	<u>LOCATION CODE</u>	<u>SAMPLE DEPTHS (ft bgs)</u>	<u>TOTAL SAMPLES</u>	<u>COLLECTION METHOD</u>	<u>ANALYTICAL PARAMETERS</u>
<b><u>Loading Rack Area</u></b>					
south corner, near W-1	LR-1	1.5-2.0 4.3-5.0	2	Hand Auger	TPH (GC/FID); VO+10; PAHs; microbiological activity
east corner, near office	LR-2	1.5-2.0 3.1-3.6	2	Hand Auger	TPH (GC/FID); microbiological activity
northeast near W-4	LR-3	1.5-2.0 4.7-5.3	2	Hand Auger	TPH (GC/FID); microbiological activity
north corner, near MW-15	LR-4	1.5-2.0 4.7-5.3	2	Hand Auger	TPH (GC/FID)
east corner, near W-4	LR-5	1.5-2.0 4.7-5.3	2	Hand Auger	TPH (GC/FID)
south corner, in gravel	LR-6	1.5-2.0 3.3-3.9	2	Hand Auger	TPH (GC/FID)
northeast near former UST-3	LR-7	1.3-1.7 3.8-4.1	2	Hand Auger	TPH (GC/FID); VO+10; PAHs
northeast near W-4 and S-3	LR-8	1.5-2.0 4.4-5.0	2	Hand Auger	TPH (GC/FID)
near OWS-1	B-28	2.5-3.0	1	Hand Auger	TPH (GC/FID)
near OWS-1	B-29	3.0-3.5	1	Hand Auger	VO+10
near OWS-1	B-30	3.0-3.5	1	Hand Auger	VO+10
near OWS-1	B-31	3.0-3.5	1	Hand Auger	VO+10

TPH

Total Petroleum Hydrocarbons, USEPA Modified method 8015.

PAH

Polynuclear Aromatic Hydrocarbons, USEPA method 8270

VO+10

Volatile Organic Compounds plus 10 Library Compounds, USEPA method 8240.

960530026

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Table 1. Soil Sampling Summary Table for Samples Collected on October 11, 12, 13 and 14, 1994, ARCO's Former Bulk Storage Terminal, Newark, New Jersey.

<u>LOCATION</u>	<u>LOCATION CODE</u>	<u>SAMPLE DEPTHS</u> (ft bgs)	<u>TOTAL SAMPLES</u>	<u>COLLECTION METHOD</u>	<u>ANALYTICAL PARAMETERS</u>
<u>Septic Leach Field</u>					
east of septic tank	ST-1	0-0.5 1.5-2.0 4.0-4.5	3	Hand Auger	TPH (GC/FID) TPH (GC/FID) TPH (GC/FID)
east of piping to leach field	ST-2	0-0.5 1.5-2.0 4.2-4.7	3	Hand Auger	TPH (GC/FID) TPH (GC/FID) TPH (GC/FID)
west of septic tank	ST-3	0-0.5 1.5-2.0 3.8-4.4	3	Hand Auger	TPH (GC/FID) TPH (GC/FID); microbiological activity TPH (GC/FID); VO+10; PAHs
southeast of leach field	ST-4	0-0.5 1.5-2.0 4.1-4.6	3	Hand Auger	TPH (GC/FID); VO+10; PAHs TPH (GC/FID); microbiological activity TPH (GC/FID); microbiological activity
northeast of septic tank	ST-5	0-0.5 1.5-2.0 4.2-4.7	3	Hand Auger	TPH (GC/FID) TPH (GC/FID) TPH (GC/FID)
southwest of leach field near	ST-6	0-0.5 1.5-2.0 3.1-3.6	3	Hand Auger	TPH (GC/FID) TPH (GC/FID); VO+10; PAHs TPH (GC/FID)

TPH Total Petroleum Hydrocarbons, USEPA Modified method 8015.  
 PAH Polynuclear Aromatic Hydrocarbons, USEPA method 8270  
 VO+10 Volatile Organic Compounds plus 10 Library Compounds, USEPA method 8240.

960530027

GERAGHTY &amp; MILLER, INC.

**Table 1. Soil Sampling Summary Table for Samples Collected on October 11, 12, 13 and 14, 1994, ARCO's Former Bulk Storage Terminal, Newark, New Jersey.**

<u>LOCATION</u>	<u>LOCATION CODE</u>	<u>SAMPLE DEPTHS</u> (ft bgs)	<u>TOTAL SAMPLES</u>	<u>COLLECTION METHOD</u>	<u>ANALYTICAL PARAMETERS</u>
<b><u>Propane Power</u></b>					
Former Sample #2R0425-010	PP-1	0-0.5 1.5-2.0 4.4-5.0	3	Hand Auger	TPH (GC/FID); VO+10; PAHs; microbiological activity TPH (GC/FID); microbiological activity TPH (GC/FID); microbiological activity
<b><u>Oil/Water Separator OWS-2</u></b>					
Former sample B-51	B-51	3.0-3.5	1	Hand Auger	Lead*
<b>TOTAL SAMPLES COLLECTED</b>			42		

TPH                      Total Petroleum Hydrocarbons, USEPA Modified method 8015.  
PAH                      Polynuclear Aromatic Hydrocarbons, USEPA method 8270  
VO+10                  Volatile Organic Compounds plus 10 Library Compounds, USEPA method 8240.  
\*                          Lead Analysis, USEPA method 7421.

**960530028**

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Table 2. Analytical Results for Total Petroleum Hydrocarbons in Soil Samples Collected on October 11, 12, 13, and 14, 1994, from ARCO's Former Bulk Storage Terminal, Newark, New Jersey.

Sample ID (Field)	Depth (ft bgs)	Total Petroleum Hydrocarbons <sup>1</sup>
<b><u>Loading Rack</u></b>		
LR - 1	1.5 - 2.0	5,700
LR - 1	4.3 - 5.0	440
LR - 2	1.5 - 2.0	62
LR - 2	3.1 - 3.6	99
LR - 3	1.5 - 2.0	5,600
LR - 3	4.7 - 5.3	3,400
LR - 4	1.5 - 2.0	13,000
LR - 4	4.7 - 5.3	4,400
LR - 5	1.5 - 2.0	4,700
LR - 5	4.7 - 5.3	1,500
LR - 6	1.5 - 2.0	3,600
LR - 6	3.3 - 3.9	6
LR - 7	1.3 - 1.7	7,500
LR - 7	3.8 - 4.1	3,900
LR - 8	1.5 - 2.0	3,800
LR - 8	4.4 - 5.0	580
<b><u>Septic Tank/Leach Field</u></b>		
ST - 1	0.0 - 0.5	21,400
ST - 1	1.5 - 2.0	11,200
ST - 1	4.0 - 4.5	2,300
ST - 2	0.0 - 0.5	670
ST - 2	1.5 - 2.0	13,500
ST - 2	4.2 - 4.7	6,000
ST - 3	0.0 - 0.5	16,000
ST - 3	1.5 - 2.0	14,000
ST - 3	3.8 - 4.4	2,500 / 3,400
ST - 4	0.0 - 0.5	600 / 1,200
ST - 4	1.5 - 2.0	12,000
ST - 4	4.1 - 4.6	4,500
ST - 5	0.0 - 0.5	26,000
ST - 5	1.5 - 2.0	8,300
ST - 5	4.2 - 4.7	2,900
ST - 6	0.0 - 0.5	3,600
ST - 6	1.5 - 2.0	9,000
ST - 6	3.1 - 3.6	1,100
<b><u>Propane Power</u></b>		
PP - 1	0.0 - 0.5	3,900
PP - 1	1.5 - 2.0	33,000
PP - 1	4.4 - 5.0	19,000
<b><u>*NJDEPE Total Organic Criteria</u></b>		10,000

<sup>1</sup> All concentrations in milligrams per kilograms: equivalent to parts per million.

ftbgs Feet below ground surface.

\* New Jersey Department of Environmental Protection's Soil Cleanup Standards February 1994.

Table 3. Analytical Results for Volatile Organic and Polynuclear Aromatic Compounds in Soil Samples Collected on October 11, 12, 13, and 14, 1994, from ARCO's Former Bulk Storage Terminal, Newark, New Jersey.

								*NJDEP Soil Cleanup Criteria		
	Residential	Non Residential	Impact to							
	Direct Contact	Direct Contact	Groundwater							
Sample ID:	Soil Cleanup	Soil Cleanup	Soil Cleanup							
Depth (ft bgs):	Criteria	Criteria	Criteria							
LR-1				LR-6	LR-7	B-28	B-29	B-30	B-31	
(1.5 - 2.0)				(1.5 - 2.0)	(1.3 - 1.7)	(2.5 - 3.0)	(3.0 - 3.5)	(3.0 - 3.5)	(3.0 - 3.5)	
<u>Volatile Organic Compounds</u>										
Benzene	10	0.022	23	<0.006	0.013	<0.006	1.8	3	13	1
Toluene	<0.110	0.1	200	<0.006	<0.006	<0.006	<0.110	1,000	1,000	500
Ethyl benzene	49	0.027	88	<0.006	0.023	<0.006	20	1,000	1,000	100
Total xylenes	34	0.098	350	0.017	0.023	<0.006	4.4	410	1,000	10
Acetone	<0.670	0.11	22	<0.040	<0.030	<0.030	2.6	1,000	1,000	100
2-Butanone (MEK)	<u>&lt;0.110</u>	<u>0.016</u>	<u>&lt;1.2</u>	<u>0.023</u>	<u>0.02</u>	<u>0.014</u>	<u>&lt;0.110</u>	<u>1,000</u>	<u>1,000</u>	<u>50</u>
Total VOCs	93	0.373	683	0.040	0.079	0.014	28	NS	NS	NS
Tentatively Identified Compounds										
	10	10	NA	10	8	9	10			
<u>Polynuclear Aromatic Hydrocarbons</u>										
Acenaphthene	<1.5	<0.150	<4	NA	NA	NA	NA	3,400	10,000	100
Anthracene	0.740	0.340	<1	NA	NA	NA	NA	10,000	10,000	100
Benzo (a) anthracene	0.730	<0.037	1.2	NA	NA	NA	NA	0.90	4	500
Benzo (a) pyrene	<1.1	<0.110	<3	NA	NA	NA	NA	0.66	0.66	100
Benzo (b) fluoranthene	0.520	<0.037	1.1	NA	NA	NA	NA	NS	NS	NS
Benzo (g,h,i) perylene	<0.15	<0.150	<4	NA	NA	NA	NA	NS	NS	NS
Benzo (k) fluoranthene	<0.18	<0.180	<5	NA	NA	NA	NA	0.90	4	500
Chrysene	0.840	<0.073	<2	NA	NA	NA	NA	9	40	500
Fluoranthene	2	<0.073	2.2	NA	NA	NA	NA	2,300	10,000	100
Fluorene	2	0.730	2.3	NA	NA	NA	NA	2,300	10,000	100
Indeno (1,2,3-cd) pyrene	<1.8	<0.180	<5	NA	NA	NA	NA	0.90	4	500
Naphthalene	34	<0.073	44	NA	NA	NA	NA	230	4,200	100
Phenathrene	5.1	0.780	4.2	NA	NA	NA	NA	NS	NS	NS
Pyrene	1.9	0.12	<3	NA	NA	NA	NA	1,700	10,000	100
1-Methylnaphthalene	27	5.60	33	NA	NA	NA	NA	NS	NS	NS
2-Methylnaphthalene	<u>41</u>	<u>5.3</u>	<u>55</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NA</u>	<u>NS</u>	<u>NS</u>	<u>NS</u>
Total PAHs	115.03	12.87	141.80	NA	NA	NA	NA	NS	NS	NS

ft bgs Feet below ground surface.

mg/kg All concentrations in milligrams per kilograms: equivalent to parts per million.

ND Not detected.

NA Not analyzed.

\* New Jersey Department of Environmental Protection's Soil Cleanup Criteria February, 1994.

**960530030**

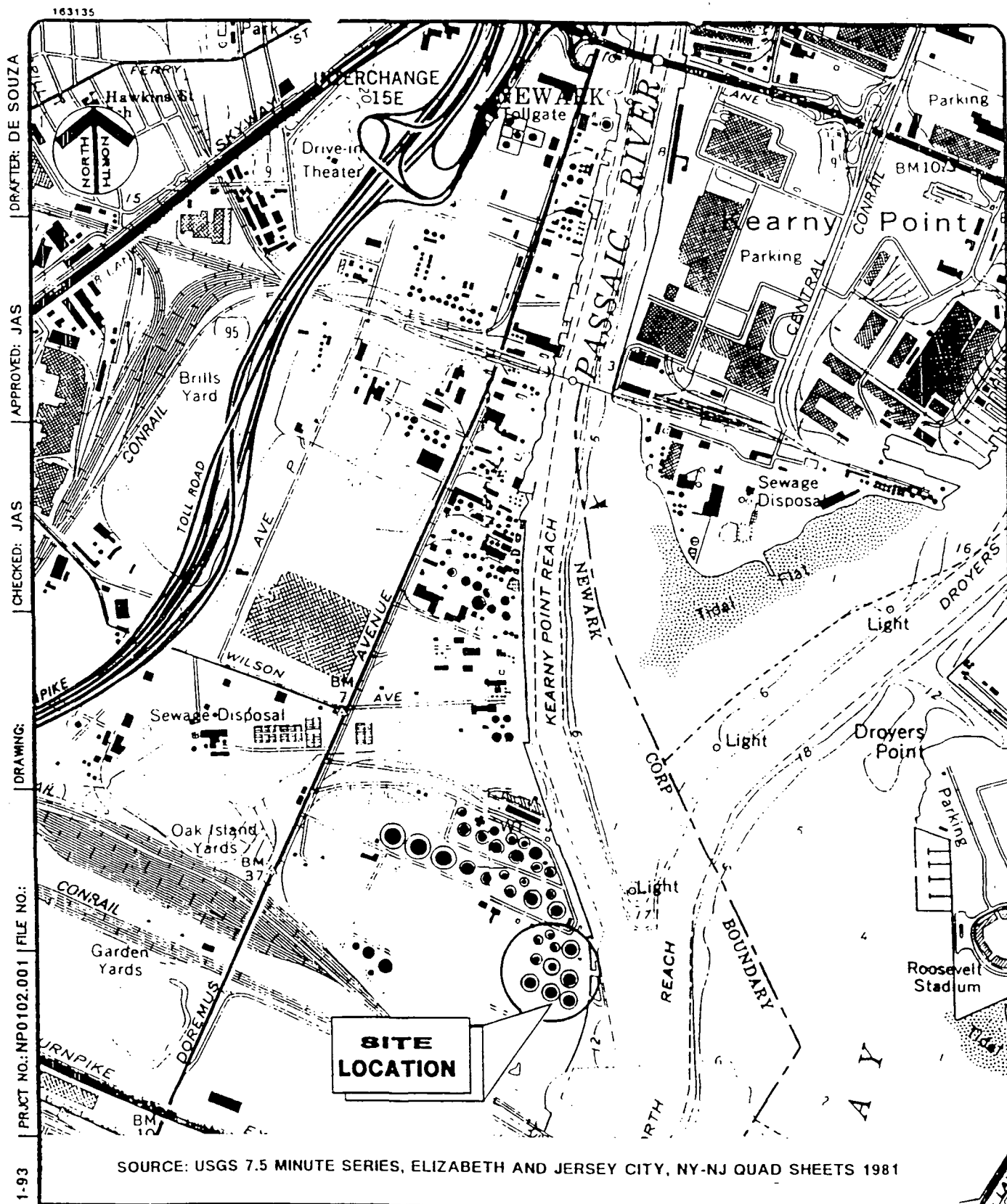
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Table 3. Analytical Results for Volatile Organic and Polynuclear Aromatic Compounds in Soil Samples Collected on October 11, 12, 13, and 14, 1994, from ARCO's Former Bulk Storage Terminal, Newark, New Jersey.

						*NJDEP Soil Cleanup Criteria		
						Residential	Non Residential	Impact to
						Direct Contact	Direct Contact	Groundwater
						Soil Cleanup	Soil Cleanup	Soil Cleanup
Sample ID:	ST-3	ST-4	ST-6	PP-1		Criteria	Criteria	Criteria
Depth (ft bgs):	(3.8 - 4.4)	(0.0 - 0.5)	(1.5 - 2.0)	(0.0 - 0.5)				
<u>Volatile Organic Compounds</u>								
Benzene	44	0.12	27	0.022		3	13	1
Toluene	46	0.74	350	<0.022		1,000	1,000	500
Ethyl benzene	130	0.250	170	<0.022		1,000	1,000	100
Total xylenes	440	29	920	<0.022		410	1,000	10
Acetone	<15	<0.740	<40	<0.130		1,000	1,000	100
2-Butanone (MEK)	<u>&lt;2.4</u>	<u>&lt;0.120</u>	<u>&lt;6.7</u>	<u>&lt;0.022</u>		<u>1,000</u>	<u>1,000</u>	<u>50</u>
Total VOCs	660	30.11	1,467	22		NS	NS	NS
Tentatively Identified Compounds	NA	NA	NA	NA				
<u>Polynuclear Aromatic Hydrocarbons</u>								
Acenaphthene	13	<0.820	<4.4	<0.740		3,400	10,000	100
Anthracene	18	0.660	<1.1	<0.180		10,000	10,000	100
Benzo (a) anthracene	29	2.5	1.3	0.670		0.90	4	500
Benzo (a) pyrene	27	3	<3.3	0.740		0.66	0.66	100
Benzo (b) fluoranthene	26	2.8	1.1	0.730		NS	NS	NS
Benzo (g,h,i) perylene	19	2.2	<4.4	<0.740		NS	NS	NS
Benzo (k) fluoranthene	25	3	<5.5	0.960		0.90	4	500
Chrysene	33	3.2	<2.2	0.880		9	40	500
Fluoranthene	60	3.2	<2.2	1.2		2,300	10,000	100
Fluorene	17	<0.410	<2.2	0.370		2,300	10,000	100
Indeno (1,2,3-cd) pyrene	20	2.2	<5.5	<0.920		0.90	4	500
Naphthalene	68	6.3	92	<0.370		230	4,200	100
Phenathrene	55	1.7	3.2	1.1		NS	NS	NS
Pyrene	53	3.3	<3.3	1.2		1,700	10,000	100
1-Methylnaphthalene	38	4.1	51	1.3		NS	NS	NS
2-Methylnaphthalene	<u>70</u>	<u>6.6</u>	<u>86</u>	<u>1.2</u>		<u>NS</u>	<u>NS</u>	<u>NS</u>
Total PAHs	571	44.76	232.20	10.35		NS	NS	NS

ft bgs Feet below ground surface.  
 mg/kg All concentrations in milligrams per kilograms: equivalent to parts per million.  
 ND Not detected.  
 NA Not analyzed.  
 \* New Jersey Department of Environmental Protection's Soil Cleanup Criteria February, 1994.

960530031



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Environmental Services

SCALE: 0 1500 FEET

## SITE LOCATION

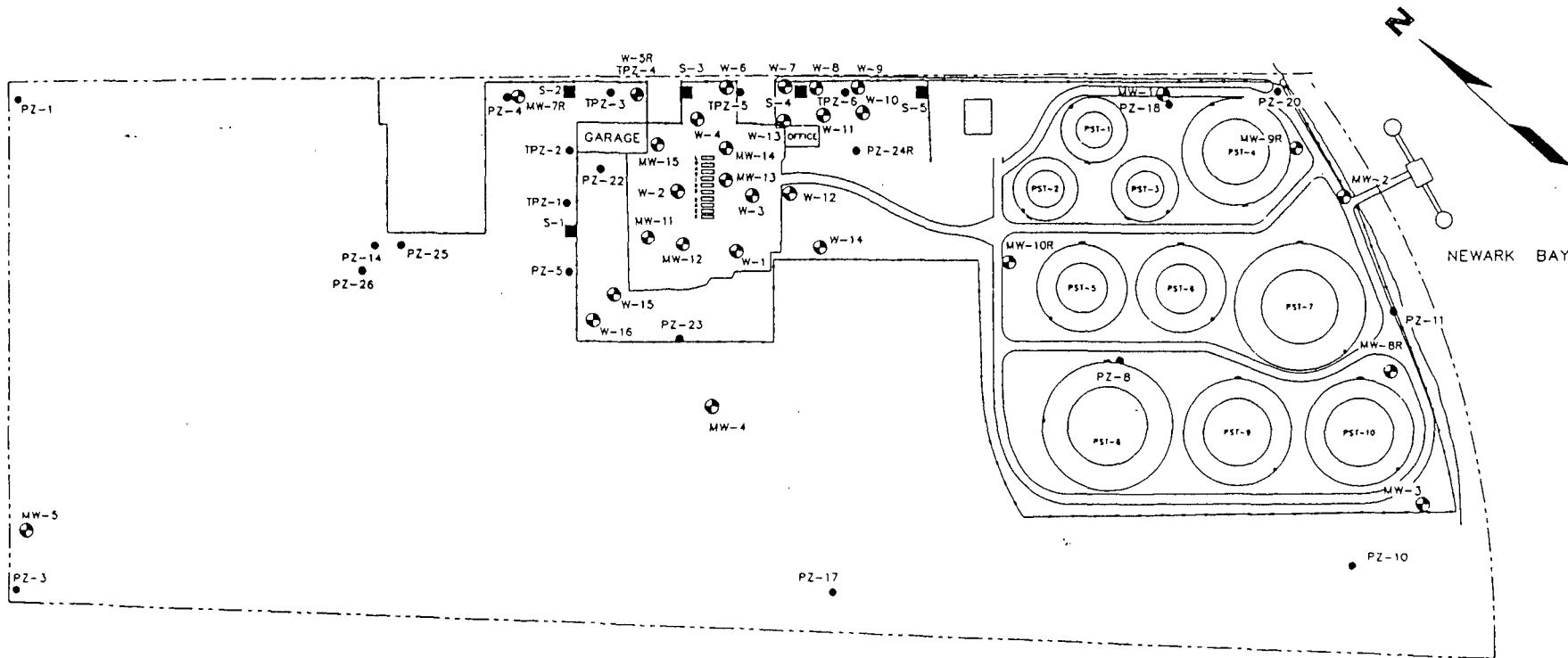
ARCO'S FORMER BULK STORAGE TERMINAL  
NEWARK, NEW JERSEY

FIGURE

1

960530032





# LEGEND

- PZ-1 • PIEZOMETER LOCATION AND DESIGNATION
- TPZ-1 • RECOVERY TRENCH PIEZOMETER LOCATION AND DESIGNATION
- MW-3 • MONITORING WELL LOCATION AND DESIGNATION
- W-12 • MONITORING WELL LOCATION AND DESIGNATION
- MW-7R • MONITORING WELL LOCATION AND DESIGNATION
- S-1 ■ RECOVERY TRENCH SUMP LOCATION AND DESIGNATION



GERAGHTY  
& MILLER, INC.  
Environmental Services

## SITE LAYOUT

ARCO'S FORMER BULK STORAGE TERMINAL  
NEWARK, NEW JERSEY

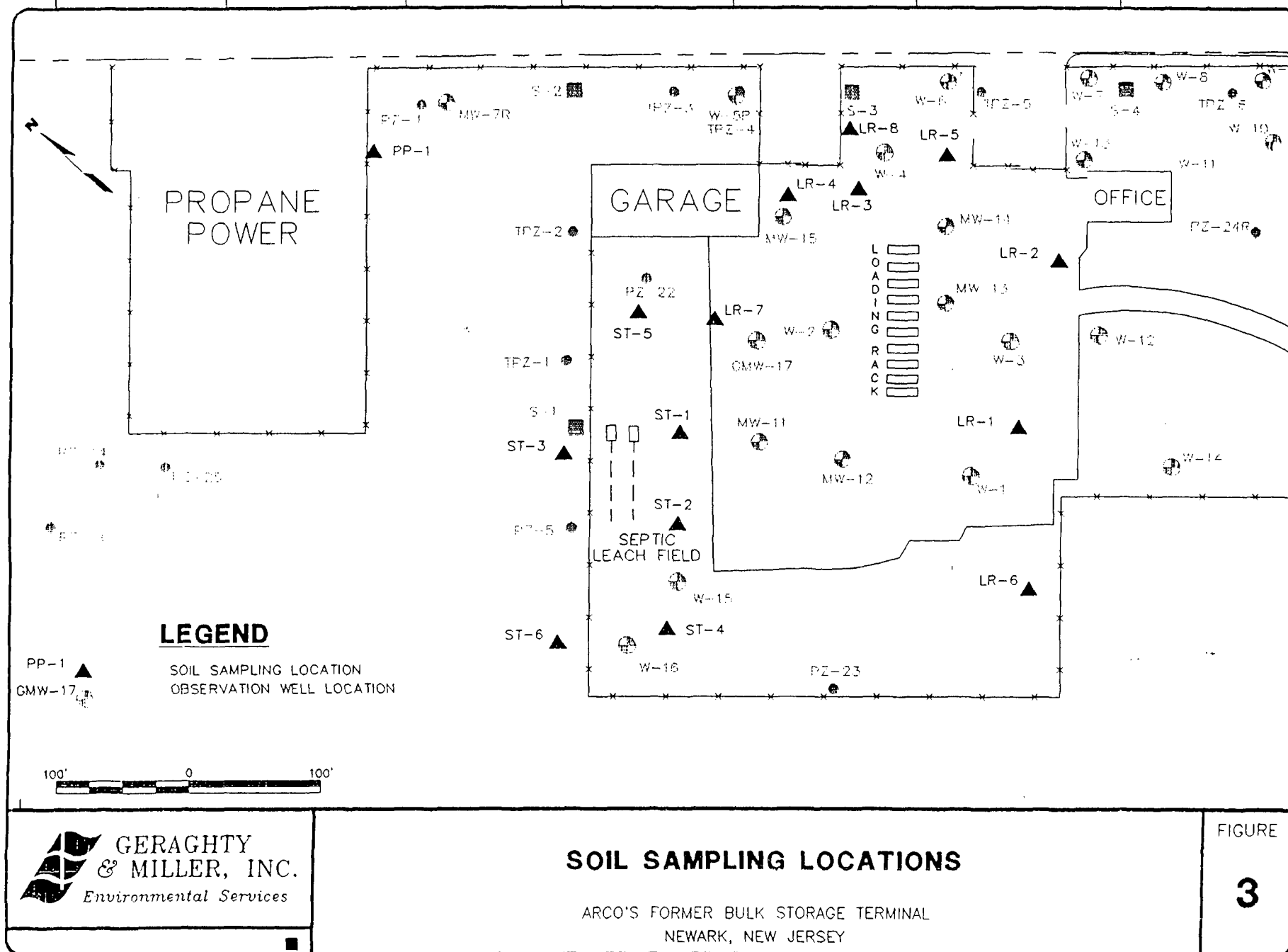
FIGURE

2

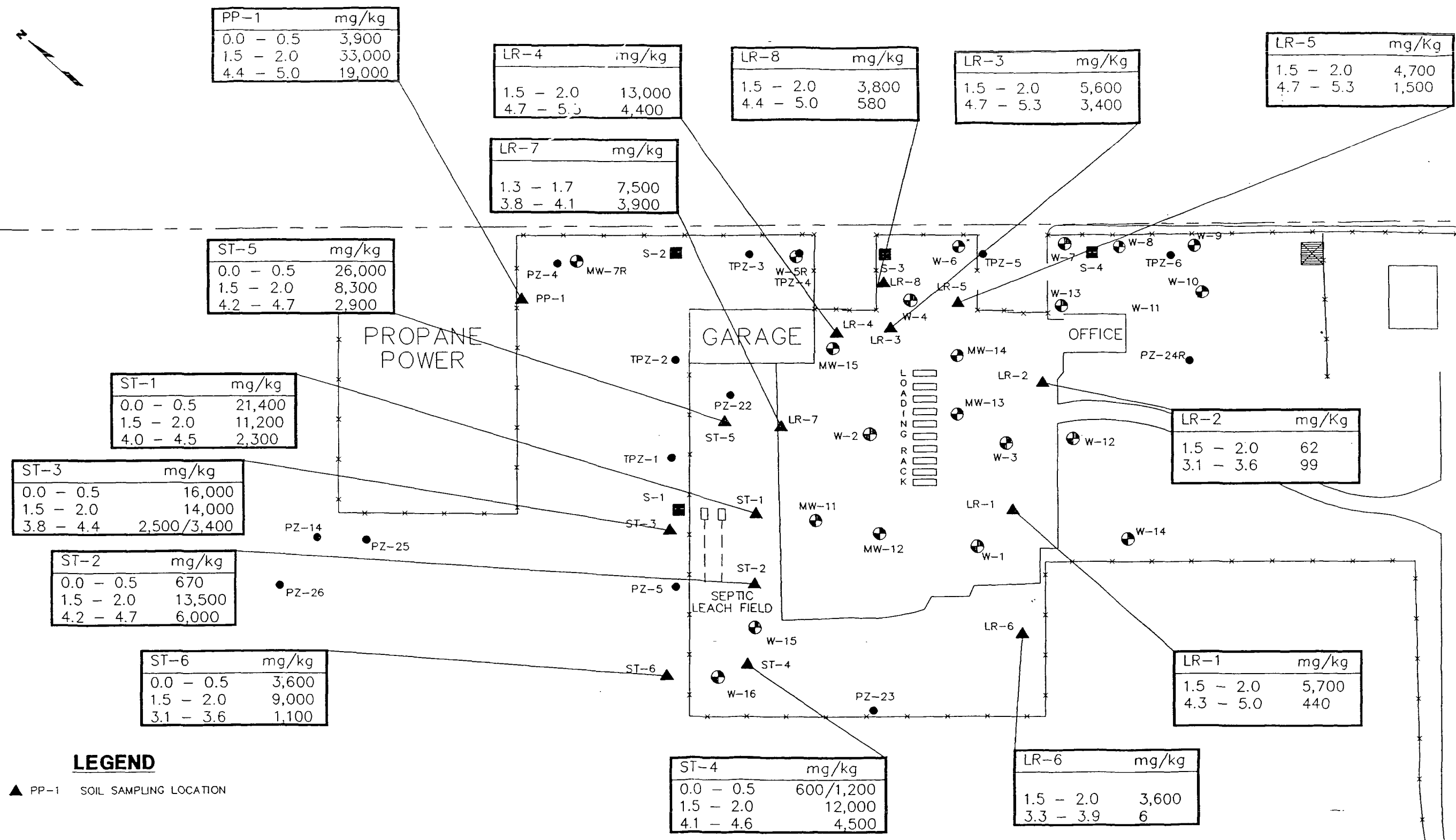
MODIFIED AFTER ROUX ASSOCIATES, INC.

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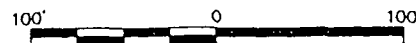


DATE: 11-02-94 PROJECT NO.: NP0191.001 FILE: 1-100 DRAWING: ARK-1 CHECKED: HORSNALL APPROVED: MIHALUCH DRAFTER: DE SOUZA



**LEGEND**

▲ PP-1 SOIL SAMPLING LOCATION



MODIFIED AFTER ROUX ASSOCIATES, INC.



**TOTAL PETROLEUM HYDROCARBONS  
IN SOIL SAMPLES**

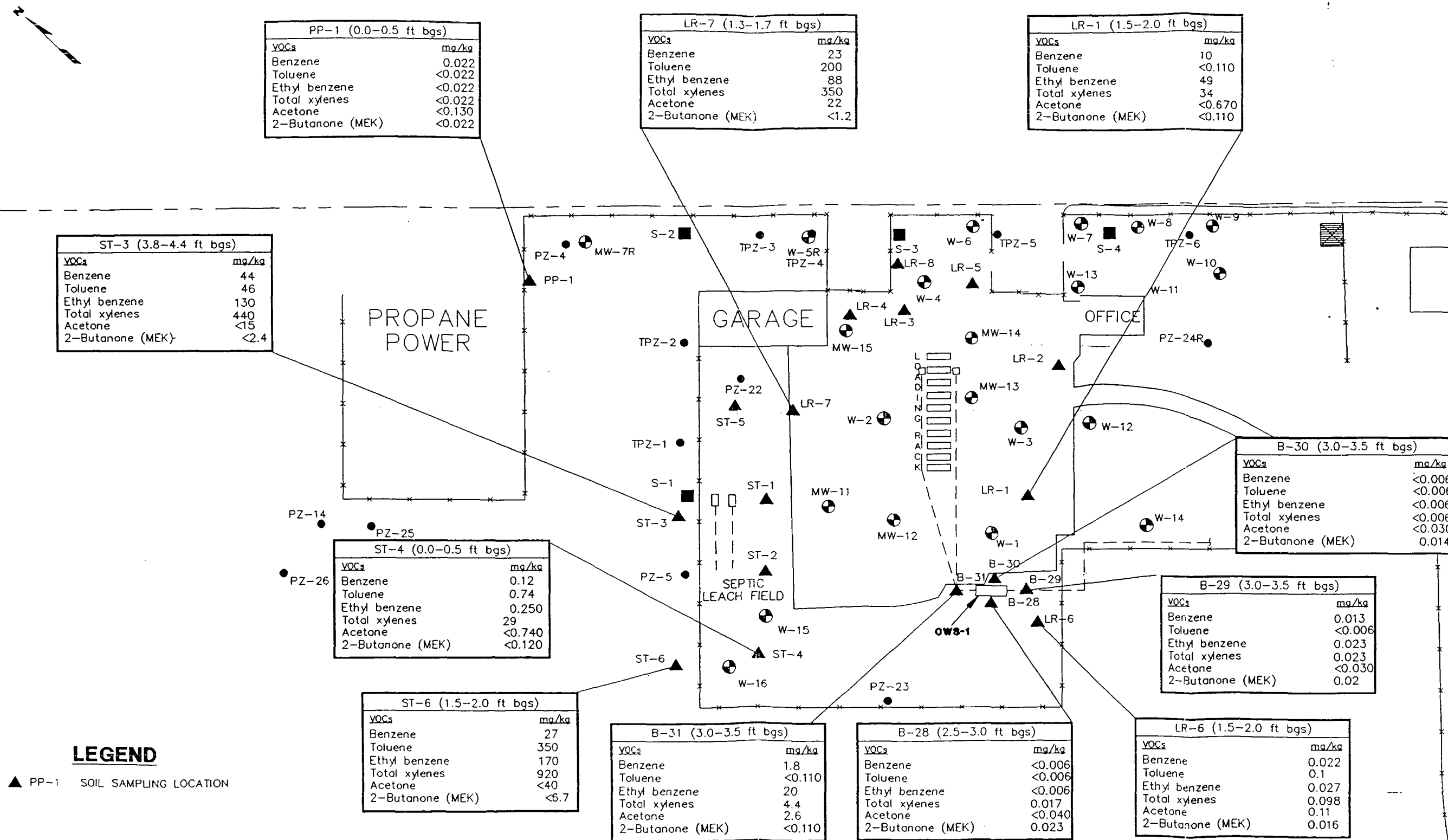
ARCO'S FORMER BULK STORAGE TERMINAL  
NEWARK, NEW JERSEY

FIGURE

**4**

960530035

DWG DATE: 11-02-94 | PROJECT NO.: NP0191.001 | FILE: 1-100 | DRAWING: ARK-3 | CHECKED: HORSNALL | APPROVED: MIHALICH | DRAFTER: DE SOUZA



MODIFIED AFTER ROUX ASSOCIATES, INC.



## VOLATILE ORGANIC COMPOUNDS IN SOIL SAMPLES

ARCO'S FORMER BULK STORAGE TERMINAL  
NEWARK, NEW JERSEY

FIGURE

5

960530036

DRAFTER: DE SOUZA

APPROVED: MIHALICH

CHECKED: HORSNALL

DRAWING: ARK-2

FILE: I-100

PRJCT NO.: NP0191.001

DWG DATE: 11-02-94



PP-1 (0.0-0.5 ft bgs)	
POLYNUCLEAR AROMATIC HYDROCARBONS - mg/kg	
Acenaphthene	<0.740
Anthracene	<0.180
Benzo (a) anthracene	0.670
Benzo (b) pyrene	0.740
Benzo (b) flouranthene	0.730
Benzo (g,h,i) perylene	<0.740
Benzo (k) floranthene	0.960
Chrysene	0.880
Fluoranthene	1.2
Fluorene	0.370
Indeno (1,2,3-cd) pyrene	<0.0920
Naphthalene	<0.370
Phenathrene	1.2
Pyrene	1.2
1-Methylnaphthalene	1.3
2-Methylnaphthalene	1.2

LR-7 (1.3-1.7 ft bgs)	
POLYNUCLEAR AROMATIC HYDROCARBONS - mg/kg	
Acenaphthene	<4
Anthracene	<1
Benzo (a) anthracene	1.2
Benzo (b) pyrene	<3
Benzo (b) flouranthene	1.1
Benzo (g,h,i) perylene	<4
Benzo (k) floranthene	<5
Chrysene	<2
Fluoranthene	2.2
Fluorene	2.3
Indeno (1,2,3-cd) pyrene	<5
Naphthalene	44
Phenathrene	4.2
Pyrene	<3
1-Methylnaphthalene	33
2-Methylnaphthalene	55

LR-1 (1.5-2.0 ft bgs)	
POLYNUCLEAR AROMATIC HYDROCARBONS - mg/kg	
Acenaphthene	<1.5
Anthracene	0.740
Benzo (a) anthracene	0.730
Benzo (b) pyrene	<1.1
Benzo (b) flouranthene	0.520
Benzo (g,h,i) perylene	<0.15
Benzo (k) floranthene	<0.18
Chrysene	0.840
Fluoranthene	2
Fluorene	2
Indeno (1,2,3-cd) pyrene	<1.8
Naphthalene	34
Phenathrene	5.1
Pyrene	1.9
1-Methylnaphthalene	27
2-Methylnaphthalene	41

ST-3 (3.8-4.4 ft bgs)	
POLYNUCLEAR AROMATIC HYDROCARBONS - mg/kg	
Acenaphthene	13
Anthracene	18
Benzo (a) anthracene	29
Benzo (b) pyrene	27
Benzo (b) flouranthene	26
Benzo (g,h,i) perylene	19
Benzo (k) floranthene	25
Chrysene	33
Fluoranthene	60
Fluorene	17
Indeno (1,2,3-cd) pyrene	20
Naphthalene	68
Phenathrene	55
Pyrene	53
1-Methylnaphthalene	38
2-Methylnaphthalene	70

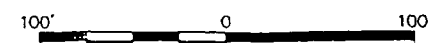
ST-6 (1.5-2.0 ft bgs)	
POLYNUCLEAR AROMATIC HYDROCARBONS - mg/kg	
Acenaphthene	<4.4
Anthracene	<1.1
Benzo (a) anthracene	1.3
Benzo (b) pyrene	<3.3
Benzo (b) flouranthene	1.1
Benzo (g,h,i) perylene	<4.4
Benzo (k) floranthene	<5.5
Chrysene	<2.2
Fluoranthene	<2.2
Fluorene	2.2
Indeno (1,2,3-cd) pyrene	<5.5
Naphthalene	92
Phenathrene	3.2
Pyrene	<3.3
1-Methylnaphthalene	51
2-Methylnaphthalene	86

LR-6 (1.5-2.0 ft bgs)	
POLYNUCLEAR AROMATIC HYDROCARBONS - mg/kg	
Acenaphthene	<0.150
Anthracene	0.340
Benzo (a) anthracene	<0.037
Benzo (b) pyrene	<0.110
Benzo (b) flouranthene	<0.037
Benzo (g,h,i) perylene	<0.150
Benzo (k) floranthene	<0.180
Chrysene	<0.073
Fluoranthene	<0.073
Fluorene	0.730
Indeno (1,2,3-cd) pyrene	<0.180
Naphthalene	<0.073
Phenathrene	0.780
Pyrene	0.120
1-Methylnaphthalene	5.6
2-Methylnaphthalene	5.3

ST-4 (0.0-0.5 ft bgs)	
POLYNUCLEAR AROMATIC HYDROCARBONS - mg/kg	
Acenaphthene	<0.820
Anthracene	0.660
Benzo (a) anthracene	2.5
Benzo (b) pyrene	3
Benzo (b) flouranthene	2.8
Benzo (g,h,i) perylene	2.2
Benzo (k) floranthene	3
Chrysene	3.2
Fluoranthene	3.2
Fluorene	<0.410
Indeno (1,2,3-cd) pyrene	2.2
Naphthalene	6.3
Phenathrene	1.7
Pyrene	3.3
1-Methylnaphthalene	4.1
2-Methylnaphthalene	6.6

LEGEND

▲ PP-1 SOIL SAMPLING LOCATION



MODIFIED AFTER ROUX ASSOCIATES, INC.



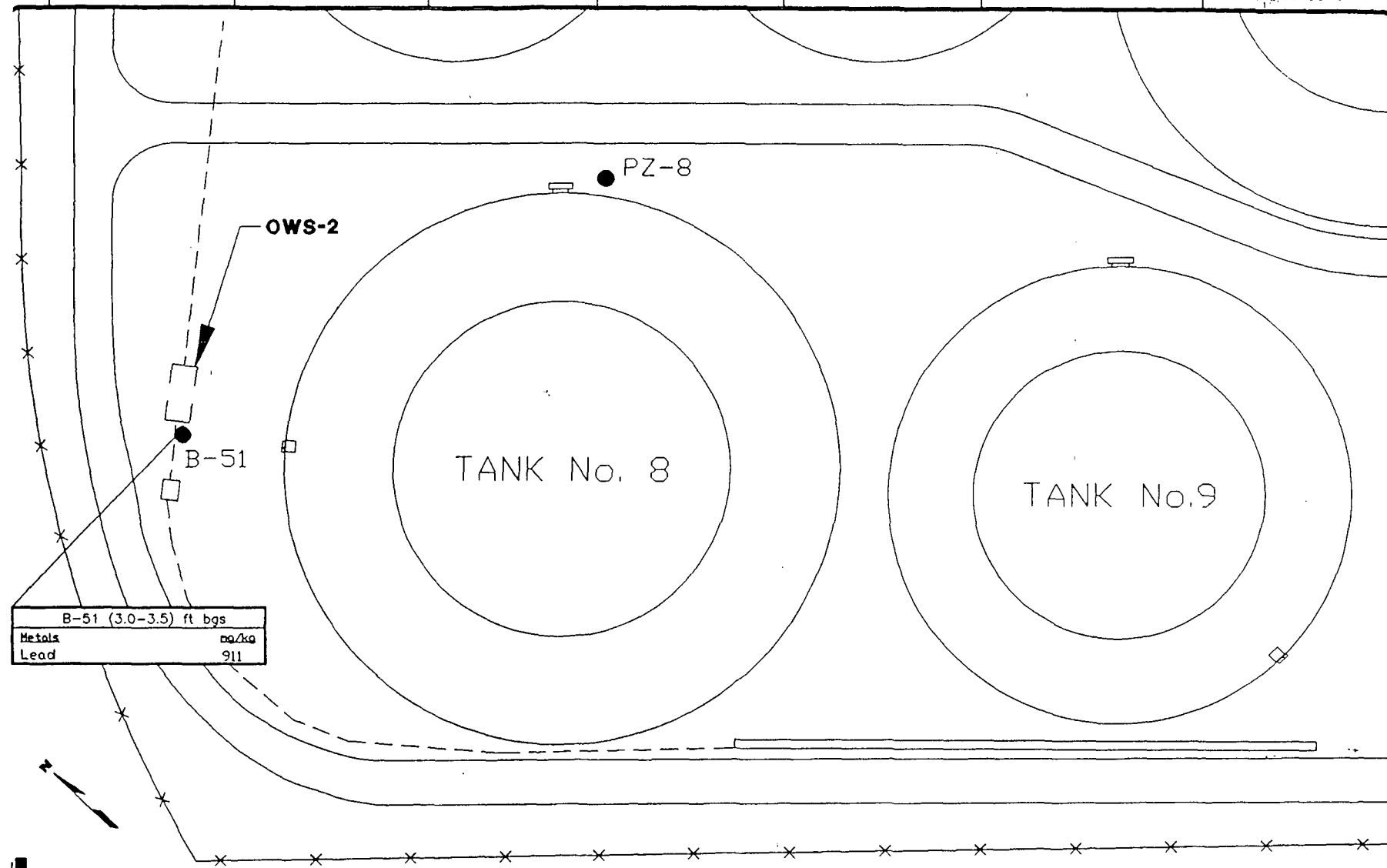
POLYNUCLEAR AROMATIC HYDROCARBONS  
IN SOIL SAMPLES

ARCO'S FORMER BULK STORAGE TERMINAL  
NEWARK, NEW JERSEY

FIGURE

6

960530037



 **GERAGHTY  
& MILLER, INC.**  
Environmental Services

# **LEAD IN SOIL SAMPLE B-51 OIL/WATER SEPARATOR OWS-2**

ARCO PRODUCTS COMPANY  
NEWARK NEW JERSEY

FIGURE

**7**

SCALE: 0  30 FEET

960530038

APPENDIX A  
SOIL BORING LOGS

**SOIL BORING LOG, PP-1, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/14/94  
Total Depth: 5 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Ted Tesler

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0.0 to 0.5	0	Brown, fine sand, some gravel-fill.
0.5 to 0.9	0	Brown, fine sand, some gravel, large rock at 0.9 feet removed.
0.9 to 1.5	110	Dark brown sand silt, some glass fragments, very slight faint petroleum odor (diesel odor).
1.5 to 2.0	100	Dark brown silt with (tan) slag and cinders; fine-medium gravel fragments, faint diesel odor.
2.0 to 3.0	110	As above-fill.
3.0 to 4.0	225	DTW 3.4 feet. Gravel and silt with some glass and terracotta fragments. Diesel odor and discoloration below 3.4-3.5.
4.0 to 4.4	235	As above.
4.4 to 5.0	380	Saturated, angular gravel and tan slag fragments, little silt, diesel odor.



**SOIL BORING LOG, LR-1, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/11/94  
Total Depth: 4.9 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0.0 to 0.9	NA	Asphalt and sub-base gravel and road ash.
0.9 to 1.5	NA	Large rock fragments and debris.
1.5 to 2.1	215	Dark brown clay, moist, with fine-medium sand (gasoline odor).
2.1 to 2.5	NA	Large rock fragment; removed.
2.5 to 2.9	NA	No sample.
2.9 to 3.6	160	Brown clay, fine to coarse gravel, saturated at 3.6 feet, (gasoline odor).
3.6 to 4.3	205	Red-brown clay (pliable) with some coarse gravel (gasoline odor).
4.3 to 4.9	180	Red-brown clay with some coarse gravel, saturated, gasoline odor.

**SOIL BORING LOG, LR-2, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/11/94  
Total Depth: 3.6 feet  
Drilling Method: Hand auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0.0 to 0.9		Asphalt and sub-base gravel.
0.9 to 1.5	600	Dark brown silty sand, moist, brown sand at base, gasoline odor.
1.5 to 2.1	1	Moist brown, sandy silt.
2.1 to 2.6	2	Dark brown, silty sand, moist at top, with gravel, wood chips, and ceramics. Saturated at 2.3 bgs.
2.6 to 3.1	2.9	Silty clay and gravel. Saturated little crushed stone.
3.1 to 3.6	0.6	Dark brown, medium to coarse gravel, rock fragments, ceramic with some silt and clay (dark brown), saturated.

**SOIL BORING LOG, LR-3, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/11/94  
Total Depth: 5.3 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0.0 to 0.6		Asphalt
0.6 to 1.5		2" crush stone with tan hike substance
1.5 to 2.1	700	Dark brown silt with fine to medium size slag cinders, glass and pottery, gasoline odor.
2.1 to 2.7	750	Dark brown silt with some clay, slag/cinders, glass and pottery (gasoline odor).
2.7 to 3.6	780	Dark brown silt with pieces of glass, pottery, wood chips with some moist clay at 3.6 feet (gasoline odor).
3.6 to 4.3	620	Dark brown silt and slag/cinders (up to 1" size) saturated at 4.0 feet (gasoline odor).
4.3 to 4.7	600	As above.
4.7 to 5.3	320	Gravel with some silt and wood pieces, pottery and glass, saturated, (gasoline odor).

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**SOIL BORING LOG, LR-4, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/12/94  
Total Depth: 5.3 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0.0 to 1.2		Asphalt 0.0-0.5, 0.5-1.2 crushed stone.
1.2 to 1.5	910	Dark brown silty sand with gravel fragments, little glass, pottery (gasoline odor).
1.5 to 2.0	1,000	As above (gasoline odor).
2.0 to 2.6	1,000	Dark brown silt with coarse to large rock fragments slag, some glass and ceramic, (gasoline odor).
2.6 to 3.4	1,000	Dark brown silt, fine to coarse gravel, some glass and ceramics (gasoline odor).
3.4 to 4.5	1,000	DTW 3.7 bgs. Brown-gray silt, assorted gravel, glass, pottery, wood chips (gasoline odor) (apparent sheen on water).
4.5 to 5.3	1,000	As above.

**SOIL BORING LOG, LR-5, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/12/94  
Total Depth: 5.2 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0.0 to 0.3		Asphalt
0.3 to 1.1		Brown silt and fine sand, large rock fragments.
1.1 to 1.5	90	Dark brown silt, some gravel, fine to coarse, glass, pottery (slight gasoline odor)
1.5 to 2.0	>1,000	Dark brown silt, slag, cinders (tan), fine to coarse moist, gasoline odor.
2.0 to 2.9	>1,000	Brown to gray, fine to coarse slag-gravel fragments. Moist, gasoline odor.
2.9 to 3.8	>1,000	As above with glass and ceramics, moist, gasoline odor, DTW 3.8, apparent sheen.
3.8 to 4.5		Gravel and ceramics with brown silt, saturated, (gasoline odor) apparent weathered sheen.
4.5 to 5.2		Gravel, little silt and glass and ceramic fragments (gasoline odor). Saturated.

**SOIL BORING LOG, LR-6, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/12/94  
Total Depth: 3.9 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0.0 to 1.1		Gravel and brown fine sand.
1.1 to 1.5	6	Red-brown fine sand, little silt, and rounded pebbles. (Weathered fuel odor)
1.5 to 2.0	38	As above, no pebbles, moist.
2.0 to 2.8	24	Medium-fine, red brown sand, little silt (slight fuel odor) DTW 2.4 feet.
2.8 to 3.3	0	Medium-fine, red-brown, sand (organic odor), saturated.
3.3 to 3.9	0	Saturated brown medium sand with some clay.

**SOIL BORING LOG, LR-7, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/12/94  
Total Depth: 4.1 feet  
Drilling Method: Hand auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0.0 to 0.3		Asphalt; water below asphalt; DTW 0.3 feet.
0.3 to 1.3	>1,000	Dark brown, fine to coarse sand with assorted gravel; medium to coarse, some glass fragments, saturated, (gasoline odor).
1.3 to 1.7	>1,000	As above, semi saturated.
1.7 to 2.5	>1,000	Dark brown, fine to coarse sandy silt with glass fragments (petroleum odor).
2.5 to 3.1	>1,000	Silt, black and wood chips; petroleum odor, moist to wet at 3.0 feet.
3.1 to 3.8	>1,000	DTW 3.0. Silt, black, and gravel with wood chips, wire; petroleum odor, saturated.
3.8 to 4.1	>1,000	Medium gravel, with little pottery fragments and some silt, saturated, gasoline odor.

**SOIL BORING LOG, LR-8, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/12/94  
Total Depth: 3.9 feet  
Drilling Method: Hand auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0.0 to 0.4		Asphalt.
0.4 to 1.0	NA	Dark brown, silty sand, large crushed stone (2" diameter).
1.0 to 1.5	980	Dark brown, silty sand, tan slag/cinders, glass fragments, coal, moist, gasoline odor.
1.5 to 2.0	>1,000	Dark brown, silt with some sand, small, rock, glass, and pottery fragments, coal fragments (gasoline odor).
2.0 to 2.4	>1,000	Obstruction at 2.4 feet bgs. As above.
2.4 to 2.8	>1,000	Another obstruction at 2.8. As above.
2.8 to 3.5	NA	Cement.
3.5 to 3.9		Dark brown silt and gravel; saturated DTW≈3.4 feet, gasoline odor.
3.9 to 4.4	>1,000	As above saturated, gasoline odor.
4.4 to 5.0	>1,000	Dark brown, silt with coarse to fine gravel; wood fragments, pottery and glass, gasoline odor, apparent sheen.

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**SOIL BORING LOG, ST-1, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/13/94  
Total Depth: 4.5 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0.0 to 0.5	100	Brown silt with gravel, small to medium fragments of glass and ceramics, gasoline odor.
0.5 to 1.2	>1,000	Dark brown, silt with fine to coarse gravel, slag, pottery, gasoline odor.
1.2 to 1.5	>1,000	Brown-gray silt with shale fragments, little plastic and ceramics, moist, gasoline odor.
1.5 to 2.0	>1,000	Dark brown silt, tan slag fragments, small to medium, moist, gasoline odor.
2.0 to 3.0	>1,000	Brown-gray, silt and slag fragments small as above, wet. 3.0 feet gasoline odor
3.0 to 4.0	>1,000	Gravel with some dark brown silt, saturated (DTW≈4.0) (gasoline odor) weathered sheen.
4.0 to 4.5	>1,000	As above.

**960530049**

**SOIL BORING LOG, ST-2, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/13/94  
Total Depth: 4.7 feet  
Drilling Method: Hand auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

Sample/Core Depth (feet below land surface)	OVA (ppm)	Sample Description
0.0 to 0.5	325	Red-brown silt with little rock fragments (gasoline odor).
0.5 to 1.0	>1,000	Dark brown silt with rock fragments, some ceramic and pottery fragments, (gasoline odor).
1.0 to 1.5	>1,000	Black, clayey silt (moist), with rock fragments, glass, ceramics, little wood chips.
1.5 to 2.0	>1,000	Dark-brown silt with small to medium, tan, glass fragments, little coal cinders, moist, gasoline odor.
2.0 to 2.7	>1,000	Black, clayey silt with some rock fragments, moist, gasoline odor.
2.7 to 3.7	1,000	Black clay, saturated, 3.1 to 3.6 feet half minor rock fragments, gasoline odor, DTW≈3.2 feet.
3.7 to 4.2	1,000	As above.
4.2 to 4.7	1,000	Gravel, some clay, little silt, saturated, gasoline odor.

**SOIL BORING LOG, ST-4, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/13/94  
Total Depth: 4.6 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0.0 to 0.5	200	Brown silt with medium, gravel (very slight gasoline odor).
0.5 to 1.0	615	Dark brown silt with medium gravel, little red brick, weathered gasoline odor.
1.0 to 1.5	920	Dark brown silt with gravel, glass, ceramics, weathered gasoline odor.
1.5 to 2.0	590	Brown-gray silt with fine to medium gravel, red brick and pottery, moist, weathered gasoline odor.
2.0 to 2.8	>1,000	Brown-gray silt and tan slag cinders, fine to medium, moist, gasoline odor.
2.8 to 3.8	>1,000	Dark-brown silt and medium rock fragments saturated, DTW $\approx$ 3.1 feet.
3.8 to 4.1	910	Gravel and silt, saturated, weathered diesel/gasoline odor.
4.1 to 4.6	880	Gravel, with little silt, saturated, weathered diesel/gasoline odor, slight weathered sheen on water.

**SOIL BORING LOG, ST-5, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/14/94  
Total Depth: 4.7 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0.0 to 0.5	395	Brown silt with some gravel fragments, faint hydrocarbon odor.
0.5 to 1.0	>1,000	Brown silt with some gravel fragments, moist, gasoline odor.
1.0 to 1.5	>1,000	Dark brown silt with gravel and clay, gasoline odor.
1.5 to 2.0	>1,000	As above, moist.
2.0 to 2.5	>1,000	Dark brown to black clayey silt with gravel/slag and wood fragments, moist, gasoline odor.
2.5 to 3.5	>1,000	As above, DTW $\approx$ 3.2.
3.5 to 4.0	>1,000	As above saturated with more gravel.
4.0 to 4.7	>1,000	Silt and gravel, gasoline odor, apparent sheen on water.

**SOIL BORING LOG, ST-6, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/14/94  
Total Depth: 4.1 feet  
Drilling Method: Hand Auger  
Sampling Interval: 0.6 feet  
Prepared By: Scott Horsnall

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0.0 to 0.5	>1,000	Brown silt and rock fragments, weathered gasoline odor.
0.5 to 0.9	>1,000	Dark brown as above.
0.9 to 1.5	>1,000	As above.
1.5 to 2.0	>1,000	Dark brown-brown, sand and silt with tan slag, fine to coarse size strong gasoline odor.
2.0 to 2.5	>1,000	Black clay assorted slag and gravel; moist, gasoline odor.
2.5 to 3.0	>1,000	Black clay and assorted slag and gravel, with wood chip, saturated at 3 feet.
3.0 to 3.6	>1,000	Gravel with black clay and silt, saturated, gasoline odor, apparent sheen on water.
3.6 to 4.1		As above.

**SOIL BORING LOG, B-28, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/17/94  
Total Depth: 3 feet  
Drilling Method: Hand Auger  
Sampling Interval: Continuous  
Prepared By: Ted Tesler

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0 to 0.5	0	Gravel.
0.5 to 1	75	Yellow, coarse to medium sand (fill).
1 to 3	400	Red-brown clay, some silt, little fine sand, some black discoloration, moist, wet at 3 feet.

**SOIL BORING LOG, B-27, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/17/94  
Total Depth: 4.0 feet  
Drilling Method: Hand Auger  
Sampling Interval: Continuous  
Prepared By: Ted Tesler

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0 to 1.5	220	Course gravel fill, some clay at base.
1.5 to 3.5	360	Reddish-brown and black clay, some silt, little fine sand and gravel, moist, soft, plastic.
3.5 to 4.0	460	Wet at 3.5 feet.

**SOIL BORING LOG, B-30, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/17/94  
Total Depth: 3.5 feet  
Drilling Method: Hand Auger  
Sampling Interval: Continuous  
Prepared By: Ted Tesler

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0 to 0.5		Asphalt.
0.5 to 1.0	310	Red-brown gravel, rock fragments, some clay and fine sand.
1.0 to 2.0	>1,000	Red brown clay, some silt and rock fragments, little fine sand, some black discoloration possible slag material, slightly moist.
2.0 to 3.5	>1,000	As above, some large rock fragments, very moist.



**SOIL BORING LOG, B-31, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/17/94  
Total Depth: 4.0 feet  
Drilling Method: Hand Auger  
Sampling Interval: Continuous  
Prepared By: Ted Tesler

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0 to .5	325	Asphalt.
0.5 to 1.5		Very coarse gravel/rock fragments; red/brown.
1.5 to 2.0	>1,000	Reddish brown clay, some silt and smaller rock fragments, v. moist.
2.0 to 2.5	>1,000	Reddish brown dense clay, some silt, v. moist soft, plastic.
2.5 to 4.0	>1,000	Same as above, wet at 3.5 feet.

**SOIL BORING LOG, B-51, ARCO'S FORMER STORAGE TERMINAL, NEWARK,  
NEW JERSEY.**

Drilled Date: 10/17/94  
Total Depth: 2 feet  
Drilling Method: Hand Auger  
Sampling Interval: Continuous  
Prepared By: Ted Tesler

<u>Sample/Core Depth</u> <u>(feet below land surface)</u>	<u>OVA</u> <u>(ppm)</u>	<u>Sample Description</u>
0. to 0.5		Gravel fill.
0.5 to 2	75	Black fine sand and rock fragments, some clay and silt, little wood and organics, moist, slightly plastic.

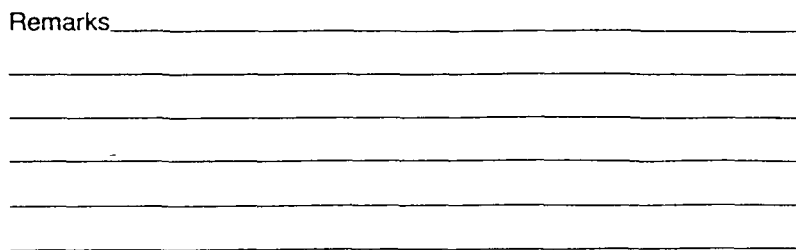
APPENDIX B

WELL CONSTRUCTION LOG FOR GMW-17.

**SOIL BORING LOG, GMW-17, ARCO'S FORMER STORAGE TERMINAL,  
NEWARK, NEW JERSEY.**

Drilled Date: 10/25/94  
Total Depth: 12 feet  
Drilling Method: Hollow-stem auger  
Prepared By: Ted Tesler

<b>Sample/Core Depth (feet below land surface)</b>	<b>OVA (ppm)</b>	<b>Sample Description</b>
0 to 1		Asphalt and very course gravel.
1 to 1.5	>1,000	Brick red fine-medium sand and fill, debris (ceramic materials).
1.5 to 4	>1,000	Gray black, gravel and slag fragments, some sandstone, gravel and brick fragments. Gasoline odor, some gray-black medium sand.
4 to 6	>1,000	Water at 4 feet and blackish/brown weathered fuel, fill as above, mostly gravel.
6 to 12	900 to 1,000	Black silt, gravel and rock fragments, wet; little to some medium to coarse sand, little wood.



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